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ABSTRACT

New non-voice services (sometimes also called information services) and the possibilities of telecommunication networks to support them are described in this state-of-the-art review. It begins with a summary of the various data transmission techniques, which include several types of data transmission over the telephone network: general, telegraph multiplexers, data multiplexers, modems for leased circuit applications, and modems for the switched telephone network. Tables are used to list specific equipment and provide additional technical details. The second section covers data transmission over public data networks and discusses user classes of service (start-stop, synchronous, and packet-operating mode of the terminal), user facilities, and data communication policy. Necessary characteristics of text for communication service (Teletex) are outlined, and features of subscriber facsimile service and videotex service are discussed. (LMM)

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GENERAL INFORMATION PROGRAMME

COMPUTER COMMUNICATIONS AND NEW SERVICES
CCITT ACHIEVEMENTS

document presented by

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1. REVIEW OF THE VARIOUS DATA TRANSMISSION TECHNIQUES

1.1 Data Transmission over the telephone network

1.1.1 General

When, in the late 1950s, the first CCITT studies were started on the subject of data transmission, they centered on the utilization of existing networks, i.e. the telex and the telephone network. At that time, little was known about the specific requirements and the potential demand for data transmission facilities and it was prudent to seek solutions which would make use of sophisticated equipment at the customer's premises but would not necessitate changes within the network. This policy triggered off considerable research efforts in the various domains of subscriber modems, telegraph transmission equipment etc. and clarified at the same time the user requirements to be taken into account. Today, a variety of transmission means are available for the customer to transmit data, ranging from simple, inexpensive modems for applications where low data transmission rates suffice, to sophisticated equipment which makes utmost use of the bandwidth available to transmit large amounts of data or to achieve fast transactions. Such equipment includes modems for use on analogue telephone type and wide-band circuits as well as transmission multiplexers for deriving several user rates from a digital bearer circuit. A short over-view is given in Tables 1-4.

1.1.2 Telegraph multiplexers

Table 1 shows the various telegraph channelling equipments. It is to be noted that the fast technological progress in digital technology has made it possible to introduce time division multiplex techniques to derive start-stop telegraph channels from digital bit streams provided by modems or data multiplexers. This technology makes better use of available bandwidth than frequency division multiplex equipment which in turn leads to increased economy of the system. On the other hand there is a trade-off between economy and code- and speed independence of the system, at least for those systems which are at the upper end of the bandwidth economy scale (e.g. R.101)

TABLE 1 : Telegraph channelling equipment for leased or switched applications

Rec.	Multiplex system	User bit rate(s)	Trans-parency	Bearer
R.37	FDM	100	CSI	Voice grade H.22
R.38A,B	FDM	200	CSI	Voice grade H.22
R.101	TDM	100, 110, 134.5 150, 200, 300	CSD	2.4 kbit/s
R.111	TDM	100 200 300	CSI	2.4 Or 4.8 or 9;6 or 64 kbit/s

1.1.3 Data Multiplexers

Table 2 shows channelling equipment to derive data channels at 600 bit/s and above from analogue (X.40) or digital bearers (X.50 series). In the latter case the bearers are provided by 64 kbit/s modems (V.36) or PCM time slots. With the exception of X.40, all other multiplexers are of the synchronous type. Both X.50 and X.51 provide the same number of channels for the various user rates, however X.50 for 6+2 bit envelopes and X.51 for 8+2 bit envelopes.

X-series multiplexers are used to provide customer leased circuits or circuits for switched data networks.

TABLE 2 : Data channelling equipment for leased or switched applications

Rec.	Multiplex system	User bit rates	Trans parency	Bearer
X.40	FDM	2.4, 9.6 kbit/s	CSI	Group band H.14
X.50	TDM	0.6, 2.4, 4.8 9.6 kbit/s	SD	6.4 kbit/s
X.50 bis	TDM	48 kbit/s	SD	64 kbit/s
X.51	TDM	0.6, 2.4, 4.8 9.6 kbit/s	SD	64 kbit/s
X 51 bis	TDM	48 kbit/s	SD	64 kbit/s

Legend : FDM = Frequency division multiplex
TDM = Time division multiplex
CSI = Code and speed independent
CSD = Code and speed dependent
SD = Speed dependent

1.1.4 Modems for leased circuit applications

Table 3 lists the various CCITT recommended modems for use on leased analogue circuits, be they conditioned telephone-type circuits according to CCITT Recommendation M.1020 or group band circuits to Recommendation H.14.

Recommendation V.26 provides no scrambler or equalizer; V.27 a scrambler and a manual equalizer; V.27bis and V.29 a scrambler and an automatic adaptive equalizer; the group band modems V.35 and V.36 provide a scrambler.

As to the phase change encoding, Recommendations V.27 and V.27bis use the same scheme at the bit rate of 4.8 kbit/s whereas the encoding scheme of V.27 bis at the 2.4 kbit/s fall back rate is the same as alternatives of V.26. V.29 offers, in addition to the functions of a modulatory/demodulator,

the possibility of adding a multiplexer to derive sub-channels at rates of 2.4, 4.8, and 7.2 kbit/s from the main bit rate which is now used as an aggregate bearer. Any mix of sub-channels within the limits of the aggregate bearer rates is possible, e.g. 4 sub-channels at 2.4 kbit/s on a 9.6 kbit/s aggregate rate or one sub-channel at 4.8 and one at 2.4 kbit/s on the fallback aggregate rate of 7.2 kbit/s. The facility is particularly useful to provide bearers for telegraph time division multiplex equipment.

In general, voice-band modems are used to provide customer leased point-to-point and multipoint applications, bearers for telegraph multiplexers and, in come cases, trunk circuits and extensions for data networks.

Group band modems are applicable, inter alia, to the use as leased circuits, bearers for telegraph and data multiplexers and as bearer for common channel signalling systems.

TABLE 3 : Modems for use on leased analogue circuits

Rec.	Modulation system	Data bit rate(s)	Mode of transmission	Supervisory channel rate	Mode of operation	Bearer
V.26	4 PHD	2.4 kbit/s	SYNC	75 baud	4-wire duplex	Voice M.1020
V.27	8 PHD	4.8 kbit/s	SYNC	75 baud	4-wire duplex 2-wire half duplex	Voice M.1020
V.27 bis	8 PHD 4 PHD	4.8 kbit/s 2.4 kbit/s	SYNC	75 baud	4-wire duplex 2-wire half duplex	Voice M.1020
V.29	AMPH	9.6, 7.2, 4.8, 2.4 kbit/s	SYNC	-	4-wire duplex 2-wire half duplex	Voice M.1020
V.35	AMSSB	48 kbit/s 40.8 "	SYNC ANISOC	Speech	4-wire duplex	Group band H.14
V.36	AMSSB	72, 64, 56 48 kbit/s	SYNC	Speech	4-wire duplex	Group band H.14

Legend : PHD = Differential phase modulation
AMPH = Combined amplitude and phase modulation
SYNC = Synchronous
ANISOC = Anisochronous

1.1.5 Modems for the switched telephone network

Table 4 show modems which are mainly developed for use over the switched telephone network but which can also be used over leased circuits. There are basically two groups of modems, such using the principle of multifrequency transmission (two simultaneously transmitted frequencies to indicate one or half a character) either employing the telephone push button signalling frequencies (V.19) or a universal frequency set or on the other hand, modems transmitting data in a bit-serial order in which case there is no restriction on the size of the character set.

Recommendation V.26bis uses a fixed compromise equalizer and no scrambler, its modulation scheme at 2.4 kbit/s corresponds with alternative B of Recommendation V.26. Recommednation V.27ter employs an automatic adaptive equalizer and a self-synchronizing scrambler. Recommendation 27ter corresponds basically with Recommendation V.27bis, except the additional provision in the synchronizing signal for protection against talker echoes and the difference in interchange circuits due to its application on the switched network.

Again, as in the case of Table 3, the ascending numbering of recommendations indicates the chronological emergence of these modems and, at the same time, their increased performance and sophistication.

Table 4 : Modems for use on the switched telephone network or on leased circuit

Rec.	Modulation system	Data bit rate(s)	Mode of transm.	Supervisory channel rate	Mode of operation
V.19	2FC	10 char/s	ANISOC	Audible or 5 or 75 baud or voice answering	One way transmission form outstation to instation
V.20	2F2, 2F3 2x2F2 2F2	 20 char/s 40 char/s	ANISOC Untimed Timed	as above	as above
V.21	FSK	200 bit/s	ANISOC	-	Duplex
V.23	FM	600 bit/s 1200 bit/s	ANISOC SYNC	75 baud	Half-duplex
V.26bis	2PHD 4PHD	1200 bit/s 2400 bit/s	SYNC	75 baud	Half-duplex
V.27ter	4PHD 8PHD	2400 bit/s 4800 bit/s	SYNC	75 baud	Half-duplex

Legend : 2F2 = 2 frequencies out of 2 groups of 4 frequencies
2F3 = 2 frequencies out of 3 groups of 4 frequencies
2x2F2 = 2x2 frequencies out of 2 groups of 4 frequencies
FSK = Frequency shift keying

1.2 Data Transmission over public data networks

1.2.1 General

The members of CCITT have recognized at an early stage of their studies on data communiations that the transmission facilities over the telephone network will have to be complemented by offereing services over public data nerworks. Such dedicated networks would be tailored to meet specific needs of the data communication community in abiding by the principle that any needs which cannot be satisfied by the telephone networks without having to change them will have to be taken care of by dedicated networks.

After a thorough evaluation of the various requirements CCITT was able to set up two basic Recommendations on the user classes of service (Recommendation X.1) and the user facilities (Recommendation X.2) to be provided by public data networks.

1.2.2 User classes of service

There are three user classes of service i.e. start-stop, synchronous and packet operating mode of the terminal (see Table 5 below). The data signalling rates are in line with those specified for modems over the telephone network. Thus, the same terminals will be able to operate at standardized bit rates either over the public telephone network or over the public data network. Moreover, with this arrangement interworking between terminals connected to different networks will be eased. For instance, user class of service 1 (50-200 bit/s) on the PDN corresponds with a modem to Recommendation V.21 over the PSTN; class of service 1 (300 bit/s) with a selected application ov V.21; user classes 3-11 with the various voice-grade and group band modems.

Table 5 : User classes of service for public data networks

a) Terminal operating mode - start-stop (see Note 1)

User class of service	Data signalling rate and code structure
1	300 bit/s, 11 units/character, start-stop
2	50-200 bit/s, 7.5-11 units/character, start-stop

b) Terminal operating mode-synthesis

User class of service	Data signalling rate
3	600 bit/s
4	2400 bit/s
5	4800 bit/s
6	9600 bit/s
7	48000 bit/s

c) Terminal operating mode - packet (See Note 2)

User class of service	Data signalling rate
8	2400 bit/s
9	4800 bit/s
10	9600 bit/s
11	48000 bit/s

Note 1 - Class 2 will provide, in the data transfer phases, for operation at the following data signalling rates and code structures:

50 bit/s (7.5 units/character)
100 bit/s (7.5 units/character)
110 bit/s (11 units/character)
134.5 bit/s (9 units/character)
200 bit/s (11 units/character)

Note 2 - In a packet switched data transmission service it should be noted that terminals in different user classes of service may be connected together by means of a packet switched connection.

1.2.3 User facilities

The user facilities so far standardized, are given in Table 6 below. They are subdivided in essential and additional facilities, either on a per call basis or assigned for an agreed contractual period. As a principle, facilities which are applicable for both the circuit switched and the packet switched service, should also be provided for both services. For instance, the closed user group facility is to be found for both services as an essential facility. A closed user group facility permits members of the group to communicate with each other but precludes communication with all other users of the service. Another important facility in the circuit switched service is the Direct Call where a call request is interpreted as an instruction to the switch to establish a connection with a single destination previously designated by the user. A typical application is a terminal of a seat reservation system. The corresponding facility in the case of the packet switched service is the Permanent Virtual Circuit which provides a permanent association between two terminals without requiring a call set-up procedure.

c) Leased circuit service (See Note 1)

User facility	User classes of service	
	1-2	3-7
Point-to-point	E	E

E = an essential user facility to be made available internationally.
A = an additional user facility which may be available in certain public data networks and may also be available internationally.
DG = applicable when the datagram facility is being used.
VC = applicable when the virtual call facility is being used.
PVC = applicable when the permanent virtual circuit is being used for certain user classes of service.
- = not applicable.

Note 1. - It is assumed that terminals have an interface to only one of the three data transmission services identified.

Note 2. - The subject of interworking between data terminals having interfaces to different data transmission services is for further study

Note 3. - The interface signalling scheme for terminals in these user classes of service having an interface to the packet switched data transmission service is for further study.

Note 4. - For further study.

2. Data communication policy

With the introduction of data transmission facilities over the public telephone network, it has been the general policy to standardize in CCITT inter alia the terminal interfaces, the data rates and the modulation procedures of the modems so that compatibility between two modems of different make can be achieved. It has been left to the user, however, which use he makes of the facility and how he organizes the information transfer. Consequently, there is a variety of different applications, e.g. batch transfer of large amounts of data, data collection by polling several data sources, interactive systems for information retrieval from data bases, seat reservation systems, point of sale systems etc. Typical for most of these systems is the fact that they are operated as closed systems with well identified members having subscribed to the service and with procedures which may vay from system to system. This policy has so far worked very well and has no doubt stimulated innovation in the application of data communications.

As a complementary utility, Adminstrations now plan to introduce new high-speed message services and an information retrieval service with standardized procedures. A brief description of these services is given hereafter.

Table 6 : International user facilities in public data networks

a) Circuit switched service (See Notes 1 and 2)

User facility	User classes of service	
	1-2	3-7
Optional user facilities assigned for an agreed contractual period		
Direct call	E	E
Closed user group	E	E
Closed user group with outgoing access	A	A
Calling line identification	A	A
Called line identification	A	A
Optional user facilities per call		
Abbreviated address calling	A	A
Multi-address calling	A	A

b) Packet switched service (See Notes 1-4)

User facility	User classes of service			
	1-7	8-11		
	See Note 3	DG	VC	PVC
Optional user facilities assigned for an agreed contractual period				
Permanent virtual circuit (PVC)	E	-	-	E
Closed user group	E	A	E	-
Closed user group with outgoing access	A	A	A	-
Packet assembly and/or disassembly	E	-	-	-
Optional user facilities per call				
Abbreviated address calling	A	See Note 4		-
Datagram (DG)	See Note 4	A	-	-
Virtual call (VC)	E	-	E	-

3. Text communication service (TELETEX)

Experience with the Telex service has shown that full compatibility between terminals and uncomplicated procedures are the key to a successful worldwide service. There is, in addition to telex, a big potential market for fast text communication services to replace part of the traditional mail or other services. Main features for such a service are considered to be high speed transmission in the order of 10 sec per A4 page side, availability of the various national typewriter alphabets, text editing capability, reproduction at a distance in the lay-out of the original, possibility to use any public telecommunication network.

For these reasons, CCITT has launched a comprehensive study of all the aspects of such a service based on market surveys and field trials in a number of countries. Taking into account the three basic functions of a text communication machine, i.e. typing of the text, text editing during the various instances of approval of the letter, transmission to the addressee, it has been reported that compared with the traditional preparation and mailing of a letter the break-even point for the new service is in the order of 4-10 pages in A4 format per day, depending upon the cost of typists, as well as of mail and telecommunication facilities in a country. Apart from possible savings, the additional advantage of fast transmission and the possibility of immediate acknowledgement of receipt adds to the attractiveness of the new service.

In detail, the responsible CCITT Study Groups have laid down the following characteristics subject to approval by the VIIth Plenary Assembly in 1980 :

a) The Teletex service will be supported by the public switched telephone network and/or by the public data network, the decision which of these network(s) will be used in the various countries, is left to Administrations. For this reason, interconnecting rules will have to be established.

b) The Teletex service will interwork with the Telex service according to the Telex rules. Each Telex station will be able to send to and receive from a Teletex station and vice-versa.

c) Line transmission rate for the Teletex service will be 2400 bit/s synchronous.

d) The printing speed is left to the individual implementation of Teletex machines, a line memory will provide the necessary buffer function.

e) There will be a basic graphic character set consisting of the graphic part of the International Reference Version (IRV) of International Alphabet No. 5 with the capability of extension to a complementary set including special national characters, letters, diacritical marks and accents thus covering the needs of all languages using the Latin alphabet. The requirements of non-Latin alphabets are taken care of by further extension techniques.

For the control characters, the relevant part of the IRV will be used. A further control character set can be invoked by extension technique.

As a Teletex terminal is required to be able to present upon reception all graphic characters of the basic international Teletex repertoire and to respond to control characters, full compatibility is achieved even if some countries choose to use on a national basis only part of the complementary set for keyboard and transmission.

This philosophy enables also Administrations and customers to choose a keyboard for the Teletex machine which corresponds to their national typewriter keyboard so that there is no difference in operating a typewriter or a Teletex machine. This arrangement is essential for a smooth introduction of Teletex machines without the need to re-train staff.

f) The Teletex transmission procedures will include error protection.

g) A Teletex terminal will be identified by a unique identification code that can be released by the distant party or by the network.

h) There will be the possibility for a terminal to prepare a message locally and at the same time receive into a storage an incoming message.

Various other features of the Teletex service are still under study in CCITT but it is hoped that a complete service description together with Recommendations on the Teletex terminal characterisitcs will be available by 1980. A number of countries are already preparing for the introduction of this service on a national scale and international implementation is to be envisaged for the early 1980s. An important prerequisit is again the possibility to interconnect the various public networks for the purpose of data communication.

4. Subscriber Facsimile Service

The standardization by CCITT of a number of basic document facsimile apparatus has offered the possibility to introduce a "CCITT-regulated" facsimile service with a service description, compatibility between terminals, a subscriber directory, testing possibilities by a test center etc. in contrast to the present situation where a variety of non-CCITT standardized facsimile equipment is in use as an attachment to the public telephone network without guaranteed service features.

The CCITT groups of facsimile apparatus are classified according to the transmission time required for an A4 page and are the following:

Group 1 : 6 minutes, Recommendation T.2

Group 2 : 3 minutes, Recommendation T.3

Group 3 : 1 minutes or less, draft Recommendation T.4

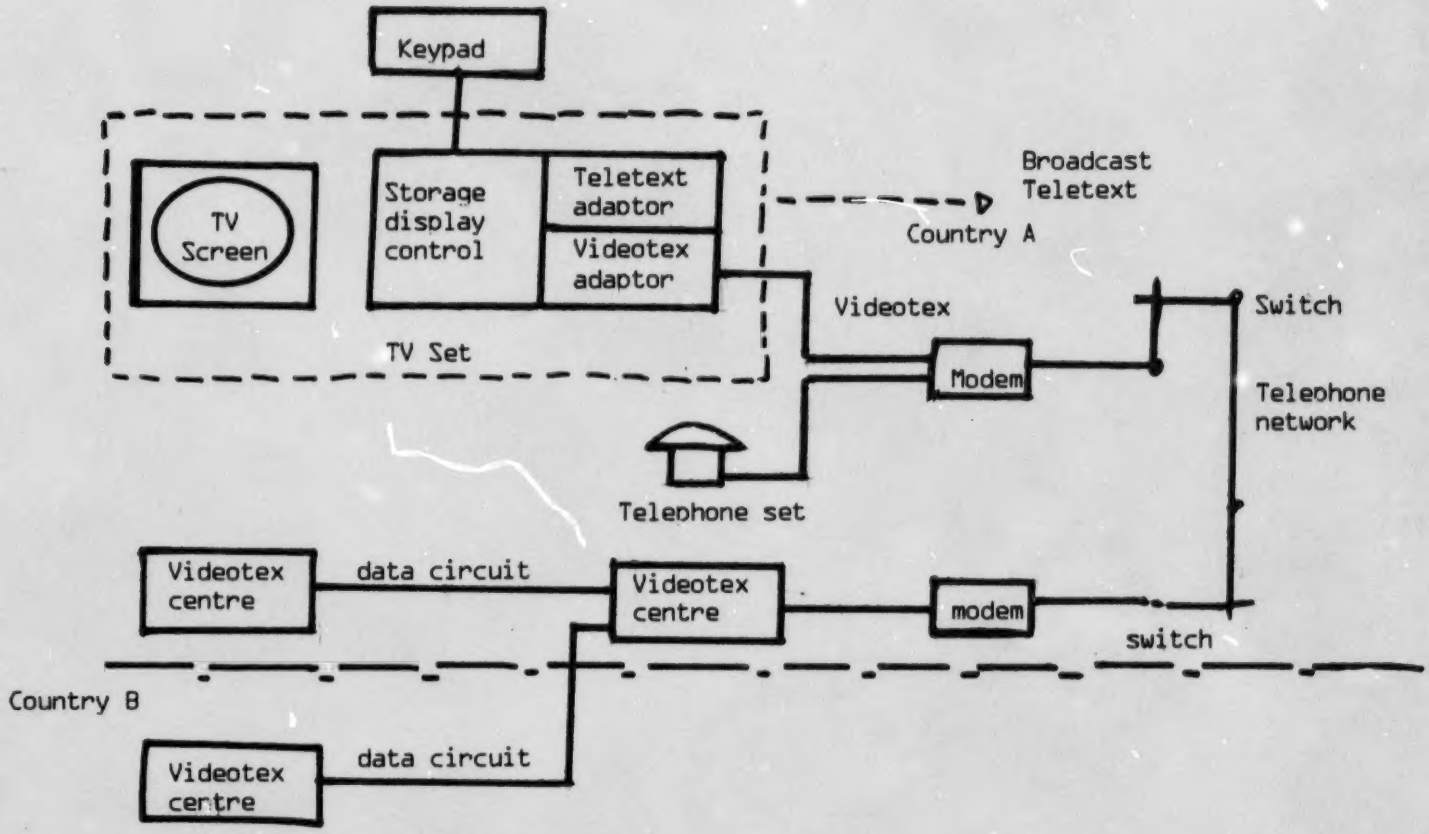
The CCITT is presently studing the introduction of a subscriber facsimile service based on the above groups of facsimile apparatus and on the procedures as decribed in Recommendation T.30. As for the Teletex service, the choice of the supporting network(s) is left to the Administrations but it is understood that Group 1 and 2 apparatus have been conceived for the telephone network, whereas Group 3 apparatus will be able to work on either the telephone or on data networks. There is a tendency to restrict the new facsimile service to Group 2 and possibly Group 3 machines in order to limit the number of differing equipment and to take account of technological progress in reducing the transmission time and increasing bandwidth economy.

The main feature of the facsimile service is the capability of transmitting copies of any script, Latin or non-Latin, diagrams, signatures etc. There is, however, no text processing capability, but on the other hand, existing typewriters can continue to be used to provide the copies for subsequent transmission by facsimile. Thus, facsimile lends itself to provide fast transmission of messages etc...including acknowledgement of receipt without changing the office organization, whereas Teletex offers considerable cost advantages by bandwidth economy and by introducing text processing which of course means a change in the office organization and replacement of typewriters by Teletex machines.

There will of course be modern offices which use already text processing typewriters without communication facility in which case a thorough evaluation of both new service offerings will have to be undertaken.

Each system, text communication and facsimile, offers advantages in specific applications and for this reason there are proposals to combine them in using a transmission procedure which is capable of carrying alphabetic and facsimile information as well provided it is in digital form. Thus, the alphabetic part of a letter for instance would be transmitted in the Teletex Alphabet at the high speed of Teletex whereas the letterhead, signature, any diagrams etc.. would be transmitted in facsimile. Studies are in the initial phase only but such a feature is considered to be very promising.

Time schedules for the facsimile service are such that in a number of countries the service is going to start in 1979 or has already started on a national basis. International implementation depends upon finalizing the draft Recommendations on the service, on the Group 3 machines and on the facsimile procedure which are expected to be available for approval by the VIIth Plenary Assembly of the CCITT in 1980.



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5. Videotex Service

In comparison with the inexpensive telephone set, terminal equipment in the digital services, be it the telex machine, a facsimile apparatus or a data terminal have always been relatively expensive, a fact which may partly be responsible for the nearly exclusive use of digital services by the business world only. Such services however could also become attractive for the private consumer if no hardcopy were required and an inexpensive display technique be found. The answer is the home television set wich exists already in many homes and is capable, in principle, of displaying texts or graphs in addition to TV images. Following this principle to use the home TV set as a visual display unit for data, maeeages or other coded information, some countries developed national information retrieval systems with the following features:

The Viedotex terminal consists of a TV set, a Videotex adaptor, a modem and a keypad. Access to a data base is obtained through the public telephone network. Once the connection is established, the customer, with his keypad, starts a dialogue with the data base to instruct it of the service he wants to obtain. The instructions from the customer to the data base are sent on the low speed backward channel of a half-duplex modem, the responses by the data base on the sata channel. The Videotex adaptor stores the incoming signals, converts them into the appropriate display control signals and finally effectuates the display on the TV screen.

There are in principle three categories of service :

a) One-way information services.

The customer will be able to receive on his screen information such as news, local events, hotel, restaurant and entertainment guides, time-tables of trains, airlines etc, advertisements such as car sales and many other information.

b) Dialogue services.

These services offer for instance the possibility to the customer to enquire on the availability of seats for a given flight or of a given article in a department store and to place directly his order. Another application is calculation services for mathematical problems for instance, for the tax declaration, for payment schedules etc. There is the possibility of training courses and tests in dialogue with a teaching program and finally, not to forget, electronic games of varying degree of sophistication.

c) Message services.

The system is also capable of offering to the customer the possibility to send a message to another Videotex customer. There will be standard texts available for events such as birthday, christmas etc..and the customer has just to select the appropriate text. If he wishes to send an individual message of any kind, he will be able to prepare the text on his own by means of his keypad. When the data base has received this message with an indication of the subscriber number of the addressee it labels the addresses's information field in the storage accordingly. Once the adressee establishes a connection to the data base, he receives a notice from the data base informing him that there is a message waiting for him. With the transmission of his subscriber number and password he receives the message on his screen.

This feature is particularly interesting in conjunction with the telex and the telegram service as a means of fast and unexpensive message delivery to a customer.

The Videotex is going to be introduced in some countries on a national basis and CCITT has approved study of Videotex as an international service. First results such as Videotex alphabet, control procedures etc...are expected for submission to the VIIth Plenary Assembly.

6. Outlook

The above brief description of new non-voice services (sometimes also called information services) and the possibilities of telecommunication network to support them shows that this whole area is in full development. Many of the innovations in telecommunications take place in the digital domaine and the resulting new services and facilities open up quite new dimensions in the ready availability of information to anyone thus contributing effectively to what is called "the information age".

It is to be expected that the proportion of digital services and resulting traffic will grow considerably over the years to come thus changing the aspect of the telephone network as a pure voice carrier and also providing a sound basis for new data networks. It is in the first instance the customer who will take advantage of the new facilities but also telecommunication administrations will profit from this stimulus to the customer to use telecommunications in applications which so far used to be the domain of other communication means or did not exist at all.